

Write your answers in the answer blank (or circle them). Show all necessary work for full credit. Answers are to be exact values unless stated otherwise.

1. Sketch the domain of $f(x, y) = \ln(x + y + 1)$

2. Sketch level curves of the following functions:

(a) $f(x, y) = \sqrt{4x^2 + y^2}$

2a. _____

(b) $f(x, y) = e^x + y$

2b. _____

3. Given $G(x, y, z) = \ln(xz) \cos(y/z)$ determine the following:

(a) $G_x =$

(b) $G_y =$

(c) $G_z =$

(d) $G_{yz} =$

(e) $G_{xx} =$

4. Evaluate the following limits

(a) $\lim_{(x,y) \rightarrow (0,0)} \frac{e^{x^2+y^2} - 1}{1 - (x^2 + y^2)}$

(b) $\lim_{(x,y) \rightarrow (0,0)} \frac{x^2 - xy - 6y^2}{(x^3 - 27y^3)}$

5. Find the equation of the tangent plane and normal line to $xy + yz + xz = -3$ at $(1, -2, 1)$

6. Given $\cos(xyz) = 1 + x^2y^2 + z^2$, find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$

7. Given $f(x, y) = x^2e^{-y}$ find the directional derivative at $P(-2, 0)$ toward $Q(2, -3)$

8. Find any local extrema or saddle points of $f(x, y) = x^2 - xy + y^2 + 9x - 6y + 10$

9. Use Lagrange Multipliers to find any extrema.

$$f(x, y, z) = xyz, \text{ given the constraint } x^2 + y^2 + z^2 = 3$$